A SURVEY ON THE USE AND IMPACT OF INFORMATION TECHNOLOGY IN QUANTITY SURVEYING SERVICE DELIVERY IN NIGERIA

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The construction industry has recently witnessed a paradigm shift from traditional paper-based method of service delivery to electronic information exchange using Information Technology (IT), at least in the western world like UK. It is now evident that the adoption of IT can enhance construction productivity and improve communications for effective decision-making and coordination among construction participants. The ability of the industry to avail itself of technology depends on the level of usage by construction participants including the Quantity Surveyor (QS) who plays a major role in the management of project success determinants, such as cost, time and quality. This research therefore evaluates the level of adoption of IT by QS in Nigeria and its impact in discharging their professional obligations to achieve improved service delivery. A review of the relevant literature using published sources was conducted to identify the current state and use of IT in the industry in various parts of the world. In order to assess the level of adoption of technology by QS in Nigeria and to evaluate its impact on their service delivery, data collected through questionnaires administered to practicing professionals were analysed and subsequently ranked using their mean item score (MIS) and the Kruskal Wallis H test. The research revealed that despite the average to high awareness of the importance of IT in improving service delivery and productivity, QS in Nigeria are still reluctant in using these technologies mainly due to the high initial cost of acquisition; lack of infrastructures to support its use and security concerns such as the susceptibility of IT system. It is concluded that the Nigerian Institute of Quantity Surveyors should act as a champion in raising the awareness of IT among its members and the Government should provide an enabling environment for its importation and usage.

Keywords: information technology, Nigeria, productivity, quantity surveyor, service delivery.

INTRODUCTION

It is apparent that we live in a dynamic world characterized by incessant technology change. The explosive growth of information and communication technology (ICT) otherwise shortened as information technology (IT) has had unqualifiable impact on business systems and processes (Rivard *et al.*, 2004). Advancement in IT has made possible fundamental changes in the method of practice in all businesses and industries although at different levels (Li, 2000). The global acceptance and widespread adoption has accelerated the dimensions of competition not only among

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organizations globally but among professions locally (Hampson and Tatum, 1994). The construction industry with the aim of levelling their colleagues in other industries have embraced the use of IT such as internet, computing, telephoning, satellite communication and electronic mailing to perform most, if not all of their activities (Ibidapo, 2000). The quantity surveyors' ability to avail themselves of these emerging opportunities provided by the advent of IT depends on the adoption of new technologies (Castle, 2002). There is quite a lot of development in all areas of computer application to the industry. Of note are the expert systems, artificial intelligence, knowledge-base systems (KBS), artificial neural networking (ANN), robotics and computer aided design (Arif and Karam, 2001). Rivard *et al.* (2004) opined that the evolution of IT will have a profound impact on how organizations in the architectural, engineering and construction industry operate in the way other industries such as manufacturing and banking have adopted and benefited from long ago. He noted that this is already the case in many of the developed countries around the world. In lieu of this, Honey (1998) reported that the turn of the last century has seen a reduction in paper-based operation in quantity surveying (QS) offices in UK while electronic led-processes are leading to less dependence on taking-off sheets and other ancillary stationery. The QS profession in Nigeria has experienced significant changes over the past decade in terms of the scope and type of services provided within the construction industry (Oladapo, 2006). These changes have occurred primarily in response to changing industry/client demands, IT developments, increased levels of competition for services and the vital role of the QS in achieving improved service delivery. Moreover, given the increasingly global nature of construction industry obstinate by extremely high levels of domestic competition and resultant low profit margin levels, there is no doubt that the construction industry has to improve its information flow and project delivery mechanism (Wager, 1998). Thus, as information flow increasingly become electronic, QS computing facilities, software and databases will need to develop in a compatible manner. Nigerian quantity surveyors will need to adapt to changes in work patterns to improve their efficiency and develop new markets to maintain competitive advantage and enhance profitability through the adoption of IT. In summary, the Nigeria construction industry in general and the QS profession in particular are facing the challenges of effectively utilising the rapid expanding technological environment in which it operates to its full advantage (Oyediran and Odusami, 2004). This paper therefore examines the IT products in terms of software packages available to quantity surveyors in Nigeria, the level of adoption and their impact on QS service delivery.

LITERATURE REVIEW

Studies have shown that the early 1980s is an era when Construction Industry Professionals (CIPs) were awakened to the reality of applying computer into the operations and processes in the industry. The professionals in the advanced economies have shown readiness and commitment to the adoption of computers in their operations than those in the developing economies like Nigeria. It was not until the late 1980s that researchers and practitioners in Nigeria began to draw attention of the industry to the advantages of the use of computers in the construction industry (Ayeni, 1989).

Early writers have indicated the software and hardware requirements for CIPs in performing their roles and responsibilities (Sidwell and McIntosh, 1982a and 1982b). These requirements will continue to vary depending on the technological advancement, the client and/or market demand, and the users' needs, amongst other

factors. The 1980s witnessed the use of computers for functions such as cash flow forecasting, Computer Aided Taking off (CATO), project management, accounting and cost control (Geary, 1982; Heckford, 1982; Sidwell and Cole, 1998). There were few specialist computer programmes relevant to the needs of the construction industry (Eite, 1982). The fewness of specialist computer programmes, which Eite (1982) noted, is being overtaken by the rapid development in the IT world. Wilderspin (1988) opined that the implementation of IT in many businesses has been more of accident than design. This may be connected with the absence of industry-driven IT strategy. This accounts, partly, for the level of misunderstanding, confusion and uncertainty common in the industry. His observation is still true, to a great extent, in a developing economy like Nigeria, where the level of adoption has been found to be low (Oyediran and Odusami, 2004).

Advances in the late 1980s and 1990s have shown the increasing awareness and adoption of computers by CIPs. The work of Shash and Al-mir (1997) showed the limited utilization of computers to accounting, administration, estimating, planning and control duties by Saudi contractors. Honey (1998) reported that about 83% of the quantity surveyors in the UK use computer at work and that quite a large proportion of members use general-purpose office software such as database and spreadsheet applications. He reported, in addition, that the RICS members are aware of other professional applications being introduced into the market. Thus it can be speculated that the RICS quantity surveying member, having been following the development in IT revolution, may not be caught unaware in the future. The conservativeness of the quantity surveyors has been cited as one of the reasons for their rate of IT adoption and diffusion (Cartlidge, 2002).

It is to be noted that computer use and adoption in the construction industry has been a subject of interest among the industry professionals in general. Rivard *et al.* (2004) carried out case studies on the use of IT in the Canadian construction industry in 2002. The CIPs interviewed include architects, engineers, general contractors and owners. It was reported that many of them are at the cutting edge in their use of IT for construction operation and processes. Notably, quantity surveyors (QS) were not part of the sample of the industry professionals interviewed. Some of the issues related to IT adoption identified in the study include efficiency and economy of electronic distribution of documents, and difficulty in introducing new technologies on projects due to time lag and tight budgets. Others include the industry-wide use of CAD system, cost of maintaining trained CAD and IT personnel and the loss of IT benefits to companies that lag behind in adopting IT. In all, the authors however believed that the potential benefits in the adoption of IT can spread round the industry.

Howard, Kiviniemi and Samuelson (1998) carried out a survey of IT in the construction industry in Scandinavia. The study aimed at setting a baseline for comparison when measuring growth and success of IT adoption. The results were similar to what was obtained by Rivard *et al.* (2004) in their study carried out in Canada. They indicated the dominance of CAD system in almost all design offices. A related study of the Finnish construction industry by Bäckblom, Ruohtula and Björk (2003) surveyed the use of Electronic Data Management (EDM) systems. The study indicated that there exist barriers to the efficient use of the EDM systems. The natures of the barriers, they claimed, are psychological and training. The survey of Doherty (1997) on the use of computer in the New Zealand building and construction industry was industry general and not profession specific. The survey revealed that a large minority of businesses either do not use computers or use them casually. The report

ended on a note of optimism that growth is expected in electronic information service. Expectedly, this position must have shifted in order to keep pace with the trend of development in developed economies.

The IT revolution has been developing at an exponential rate (Ashworth and Hogg, 2002). According to Heckford (1982), it is one of the two major factors that have impacted the construction industry in the last few years when there was an increase in computer ownership by construction professionals, which was associated with the availability of software packages. The second factor was the increased competition in the construction industry which compelled companies to use advance technologies to reduce cost and time, while maintaining project quality as project becomes more complex (Heckford 1982). IT became increasingly important to handle large volume of information and to manage complex projects (Adetola 1998). It is a field that offers a plethora of potential benefits and opportunities to the construction industry in general and the quantity surveying practice in particular, being a major player (Adetola, 1998). The use of IT and the integration of computer application within the QS services can help to increase the level of productivity in the construction industry and expand the range of information available and the services provided in addition to speeding up construction and reducing costs (Oyediran and Odusami, 2004). Ashworth and Hogg (2002) summarised the impact of IT in construction as increased speed of delivery and tasks execution, improved communications, enhanced quality and provision of a wider range of services. Despite the increasing importance of IT, the Nigerian construction industry and quantity surveyors are still however reluctant in its utilisation (Adetola, 1998; Oyediran and Odusami, 2004).

Several research efforts have been concentrated on the implementation of information and technology tools in the Nigerian construction industry. For example, Oyediran and Odusami (2005) studied the extent of usage of computer particularly amongst Nigerian quantity surveyors. In the same vein, Oladapo (2006) studied the influence of information and communication technology on professional practice, and Oladapo (2007) investigated the impediments to the use of ICT in the Nigerian construction industry. However, no prior attempt has been made at measuring or quantifying the level of usage and impact of IT in quantity surveying service delivery in Nigeria. The uniqueness of the work lies in the Nigerian context. Nigeria is a developing economy in Africa. The level and pace of development has been lethargic in many respects. The adoption of ICT in construction has nonetheless been found desirable borrowing from its impact in other sectors of the economy, most especially the service sector. A roadmap for ICT adoption in the Nigerian construction sector according to Oyediran and Odusami (2005) requires a benchmark study to underpin the adoption process in order to measure up to technologically advanced nations like UK. This study draws impetus from the need to fill a gap in knowledge in this area of technological innovation in construction as a thorough search of existing literature has shown the dearth of similar work in this area, particularly QS service delivery in Nigeria.

RESEARCH METHODOLOGY

Survey was used to provide answers to the issues earlier raised in the review. This involves sampling registered quantity surveyors and obtaining their views on the existing trend in the industry and also on their practice, through the use of well-structured questionnaires. The sample population for this research work includes member of the Nigerian Institute of Quantity Surveyors (NIQS) who are registered and eligible to practice as quantity surveyors. Data for the study were collected from

150 randomly selected respondents from various firms in Lagos State on the premise that 75% of construction professionals are based there while about 70% of these professionals have construction sites located in other states of the country (Adamu, 2004; Atsar, 2008). Out of the 150 questionnaires administered, 118 were received, while 108 which represent 72% of the sample population were valid for analysis. Both descriptive and inferential statistics such as frequency, percentiles, mean item score (MIS) and Kruskal Wallis H statistics were used to analyse the data generated due to the nature of the research work which is set to analyse the level and impact of IT usage. Respondents were asked to rank their answers on a 5-point Likert scale with 5 being the highest of the rating. MIS was used to rank the collected data to get the average of the obtained variables. Percentiles, that is, ratios multiplied by 100 were also used in rating a number of factors according to the degree of occurrence attached to them. The higher the percentage rating, the higher the importance or significance attached to such factors. The essence of percentile is to allocate a value between 0-100 to a factor (100 being the highest possible value) using factor size and total size. The formula is; P=n*100/N, where P is the percentage of the factor, n is the size of the factor in consideration and N is total size of the population

Mean item score (MIS) was used to analyse the likert-scale data using:

$$\mathrm{MIS} = \frac{\sum \mathrm{n_1 k_1}}{\sum \mathrm{N}} = \frac{5\mathrm{n_5} + 4\mathrm{n_4} + 3\mathrm{n_3} + 2\mathrm{n_2} + 1\mathrm{n_1} + 0\mathrm{n_0}}{\mathrm{N_5} + \mathrm{N_4} + \mathrm{N_3} + \mathrm{N_2} + \mathrm{N_1} + \mathrm{N_0}}$$

Where:

MIS = *Mean item score*

$\sum \mathrm{N}$ = *Total number of respondents*

$\mathrm{N_5}$ = *The number of respondents that choose 5, etc*

0 – 5 = *The various marks for the ranking of the factors as applicable in each case*

Kruskal Wallis H statistics were used to test the perceived level of the impact of the adoption of IT on QS roles and the chi square test was later used to interprete the results generated from it, using the formula:

$$H = \frac{12}{n(n+1)} \sum_{i=1}^{p} \frac{T_i^2}{n_i} - 3(n+1)$$

Where:

H = *Kruskal Wallis Value*

n = *Total number of sample*

T = *Rank sum*

P = *Number of sample*

The test was undertaken at 95% confidence level, that is, level of impact = 5%.

RESULTS

The data collected were analysed and presented in tables. Responses were analysed using percentile and the result presented in frequency tables, where appropriate. Responses to multiple options that require weighting were analysed using the mean ranking method and Kruskal Wallis H test explained in the methodology section. The varied nature of the respondents' organisation includes Consultant (9.3%), Contractor (12.0%), Government (23.2%), Private Company (19.4%) and Public Limited Company (36.1%). Respondents with up to 5 years of professional experience is 17.6% with 58.3% having 6 - 10 years experience whilst the remaining 24.1% have over 10 years experience in the industry.

All 108 respondents believe that information technology has an impact on quantity surveying practice. About a quarter of respondents have a very adequate knowledge of computer, over one-third have adequate knowledge and below one-third have average knowledge whilst 10.2% and 0.9% have inadequate and very inadequate knowledge respectively. The results show that one-fifth of the respondents have a very high awareness and adoption of IT, 38.0% have high, 40.8% have average and 0.9% has very low awareness and adoption of IT.

Table 1 shows that the rate of virus attack leading to loss of data was ranked first and high with mean item score of 3.88 and the least constraint is the rate at which software becomes outdated and requires updating which was ranked average.

Table 1: Barriers to the Adoption of IT by QS Firms

Barriers	N	Mean	Rank
Rate of virus attack leading to loss of data and associated problems	103	3.88	1
High initial cost of acquisition	103	3.69	2
Fear of ICT making professionals redundant	103	3.65	3
Irregular power supply	103	3.65	4
Few professional software to choose from	103	3.44	5
Inadequate job order to encourage investment in computer	103	3.32	6
Security / Privacy fears	103	3.23	7
The cost of engaging computer literate staff is high/ training on use of software	103	3.22	8
Fear of personal abuse	103	3.17	9
The rate at which software becomes outdated and requires updating	103	3.16	10

Little or none; 2- Low; 3- Average; 4- High; 5- Very High

Table 2 revealed that respondents strongly believe that enhancing productivity is the highest benefits of IT usage with a mean of 4.63, IT improves presentation ranked second whilst the least ranking goes to IT helps in decision making with mean of 3.76.

Table 3 showed that the most known and used software in quantity surveying practice in Nigeria is Masterbill with a mean item score of 3.95, whilst catopro and others like Ripaca are least known with a mean score of 2.13 and 2.07 respectively.

Table 4 indicates that the topmost reason why professionals are not exploiting the advantages inherent in IT is because of financial barrier (high initial cost) required in getting the license for the software whilst lukewarm attitude of the professionals

towards information technology ranked least. Table 5 reveals that quantity surveyors are mostly using the available software for bill preparation and final account with mean item scores of 4.46 and 4.42 respectively whilst it is least adopted for variation and feasibility study with mean item scores of 4.02 and 3.90 respectively.

Table 2: Benefits of IT Usage by Practicing QS Firms

Benefits	N	Mean	Rank
IT enhances productivity	103	4.63	1
IT improves presentation	103	4.54	2
IT makes a professional s job easier	103	4.22	3
IT gives professionals competitive advantage	103	4.22	4
IT upgrades social image of firm or organization	103	4.19	5
IT saves time in business	103	4.16	6
IT saves money in business	103	3.79	7
IT helps in decision making	103	3.76	8

Little or none; 2- Low; 3- Average; 4- High; 5- Very High

Table 3: Professional Software used by Nigerian Quantity Surveyors

Professional Software	N	Mean	Rank
Masterbill (MB3+)	74	3.95	1
QS Elite	68	2.82	2
Win QS (Estimating and QS Software)	87	2.68	3
Snape (vector)	65	2.23	4
Catopro	67	2.13	5
Others (Ripac, workmate)	72	2.07	6

Little or none; 2- Low; 3- Average; 4- High; 5- Very High

Table 4: Reasons for non-Utilisation of IT by QS Firms

Reasons for non-Utilisation	N	Mean	Rank
Financial Barrier (high initial cost)	102	3.56	1
Ignorance of the advantages of IT	102	3.42	2
Fear of new technology	102	3.40	3
Resistance to changes	102	3.36	4
Lukewarm attitude towards information technology	103	3.22	5

Little or none; 2- Low; 3- Average; 4- High; 5- Very High

It was hypothesised that that the adoption of IT had low level of impact on QS roles, and alternatively that the adoption of IT had high level of impact on QS roles. The Kruskal Wallis mean confirmed the ranking, indicated by Table 5. The Kruskal Wallis H test on the results in the table also shows that the adoption of IT has high level of impact on QS roles at $P < 0.05$. Consequently, the alternative hypothesis that the adoption of IT has high level of impact on QS roles is thereby upheld.

Table 5: Perceived Impact of IT on QS Roles

QS Roles	N	Mean item score (MIS)	Kruskal Wallis mean	Rank
Bill preparation	103	4.46	20.29	1
Final account	103	4.42	19.32	2
Valuation	103	4.39	18.39	3
Cost planning	103	4.38	17.56	4
Tendering	103	4.22	16.16	5
Cost modelling	103	4.16	15.18	6
Cost analysis	103	4.10	14.23	7
Cost control	103	4.10	14.23	7
Variation	103	4.02	13.23	8
Feasibility study	102	3.90	12.13	9

Little or none; 2- Low; 3- Average; 4- High; 5- Very High

DISCUSSION OF FINDINGS

The study revealed that all the respondents believed that information technology (IT) has a great impact on quantity surveying (QS) practice and service delivery. The test statistics showed that technology is considered to have a very high impact on bill preparation and a high impact on the other roles of a quantity surveyor such as final account preparation, valuation, tendering and even feasibility study, when it is adopted. They believed that IT can mostly help in enhancing productivity as it is rated very high. Using IT as a tool for decision making ranked last but it is still perceived as high benefit of IT usage. Despite this perceived importance attached to the use of technology in QS service delivery and the respondents' average level of computer literacy, there are some factors which they think affect its use by QS firms to actualise the opportunities offered by the adoption of IT. Financial barrier such as the high cost of acquiring the technology topped the list, followed by ignorance of the advantages that can be accrued, fear of new technology, resistance to change and lukewarm attitude towards IT respectively. Interestingly, IT awareness level and usage is on the average among the surveyed respondents as some were very aware and have had high adoption of technology in their practice. However, the major constraints of IT use in the Nigerian QS practicing firms are mainly the rate of virus attack leading to loss of data and associated problems, high initial cost of acquisition, fear of technology making professionals redundant and irregular power supply which were top on the list whilst the rate at which software becomes outdated and requires updating was ranked last as a barrier to the adoption of IT. The professional software most popular to the Nigerian quantity surveyors as revealed by the study is Masterbill (MB3+) which was rated high. Whilst QS Elite and Win QS was rated average, Snape (vector), Catopro and Others such as Ripac and Workmate were rated low and rarely used.

CONCLUSION

Based on the data presentation and analysis, the following conclusions are drawn from the findings of the study. Virtually all the professionals acknowledged that adoption of information technology (IT) has high impact on their service delivery as it can improve their productivity and enhance their work efficiently. The results showed that Technology is seen by the respondents as having high level of impact on all of the QS roles from bill preparation to tendering and feasibility study. Reasonable amount of practicing QSs in the Nigerian construction industry are computer literate and averagely aware of relevant technology but have not been exploiting it to full advantage mainly due to the initial cost of acquisition (financial barrier) and the

susceptibility of computer system to virus attack which can destroy their data. The most commonly used professional software package by Nigerian quantity surveyors is Masterbill (MB3+) while others are less popular and rarely used as perceived by the respondents.

RECOMMENDATIONS

Based on the conclusion, the following recommendations were proposed to enable QS practice in Nigeria attains its rightful position during this era of IT and to afford stakeholders in the Nigerian construction industry the opportunity to enjoy the full services rendered by a professional QS practice. The high initial cost of acquisition and maintenance cost of IT products should be subsidised by the Nigerian government to make it affordable and accessible. The Nigerian Institute of Quantity Surveyors (NIQS) which is the body that regulates the conduct and practice of QS services in Nigeria should make it a policy that computer literacy in terms of the use of relevant professional software should be part of test of professional competence for surveyors seeking professional membership. This will make quantity surveyors keep abreast of the trend in relevant technology that could improve service delivery. To enhance this, NIQS should organise at intervals, IT training for its members. Relevant industry stakeholders should also ensure that software packages imported to the country are adaptable such that local library can be incorporated into it. Above all, the government should be ready to provide an enabling environment for improved technology adoption through reduction of import duty, encouraging production in the country and providing adequate support infrastructure such as regular supply of electricity.

REFERENCES

Adamu, M. (2004), *An appraisal of cost planning in the construction process in south-western Nigeria*, unpublished M. Tech thesis, Department of Quantity Surveying, Federal University of Technology, Akure, Nigeria.

Adetola, F.O. (1998), "Quantity surveying and technology development in the next millennium", *NIQS 18th Biannual Conference*.

Arif, A.A. and Karam, A.H. (2001), "Architectural practices and their use of IT in the Western Cape Province, South Africa", *Journal of Info. Tech. in Construction*, **6**, 17-34.

Ashworth, A. and Hogg, K. (2002), *Willis practice and procedure for the Quantity Surveyor*, 11th Edition. Blackwell science Limited, London, UK.

Atsar, I.S. (2008), *Assessment of market orientation in construction related consultancy firms in south-western Nigeria*, unpublished M. Tech thesis, Department of Quantity Surveying, Federal University of Technology, Akure, Nigeria.

Ayeni, A.A. (1989), *Computers: making your choice*, Lagos QS Digest, **3**(2), 4-5.

Bäckblom, M., Ruohtula, A. and Björk, B.C. (2003), "Use of document management systems: a case study of the Finnish construction industry", *ITcon*, **8**, 367-380.

Cartlidge, D. (2002,) *New aspects of quantity surveying practice*, Butterworth Heinemann, Oxford, UK.

Castle, G. (2002), *New technology: opportunity or threat? In: D. (ed.) New aspects of quantity surveying Practice*, Butterworth Heinemann, Oxford, UK, 189-220.

Doherty, J.M. (1997), "A survey of computer use in the New Zealand building and construction industry", *Journal of information Technology in construction*. **2**, 73-86.

Eite, R.P. (1982), "A private practice's computer", *The Quantity Surveyor*, **28**(10).

Geary, R. (1982), "Computer aided taking off", *The Quantity Surveyor*, **38**(1).

Hampson, K.D. and Tatum, C.B. (1994), "Strategies for appropriate technology and competitive performance in infrastructure construction", *Proceedings of the National Construction Management Conference*, Sydney, Australia, 267-268.

Heckford, A. (1982), "The cash flow forecasting for the design and construction term using microcomputers", *The Quantity Surveyor*, **38**(4).

Honey, R. (1998), "Make IT a fundamental part of our business", *Chartered Surveyor*, **57**.

Howard, R., Kiviniemi, A. and Samuelson, O. (1998), "Surveys of IT in the construction industry and experience of the IT barometer in Scandinavia", *ITcon*, **3**, 45-56.

Ibidapo, O.O. (2000), *Appraisal of the impact of information technology in quantity surveying practice in Nigeria*, B.Tech thesis, Department of Quantity Surveying, Federal University of Technology, Akure, Nigeria.

Li, H. (2000), "The IT performance evaluation in the construction industry", *Proceedings of the 33rd Hawaii International Conference on System Sciences*, Hong Kong.

Oladapo, A.A. (2006), "The impact of ICT on professional practice in the Nigerian construction industry", *The Electronic J. of Info. Sys. in Developing Countries*, **XXIV**(II), 1-19.

Oladapo, A.A. (2007), "An investigation into the use of ICT in the Nigerian construction industry", *Journal of Information Technology in Construction*, **12**, 261-277.

Oyediran, O.S. and Odusami, K.T. (2004), "Whiter the Nigerian quantity surveyors in the information technology age", *An International Journal of Information and Communication Technology (ICT)*, **1**(1&2), 1-16.

Oyediran, O.S. and Odusami, K.T. (2005), "A study of computer usage by Nigerian quantity surveyors", *Journal of Information and Technology in Construction*, **10**, 291-303.

Rivard, H., Froese, T., Waugh, L.M., El-Diraby, T., Mora, R., Torres, H., Gill, S.M. and O'Reilly, T. (2004), "Case studies on the use of information technology in the Canadian construction Industry", *J. of Information Technology in Construction Industry*, **9**, 9-34.

Shash, A.A. and Al-mir, M. (1997), "Information technology in contractors firms in Saudi Arabia", *Construction Management and Economics*, **15**, 187-200.

Sidwell, A.C. and McIntosh, J. (1982a), "Microcomputers and the construction industry: software and hardware", *The Quantity Surveyor*, **38**(12), 234-5.

Sidwell, A.C. and McIntosh, J. (1982b), "Micro computers and the construction industry commissioning the system", *The Quantity Surveyor*, **38** (13), 253-5.

Sidwell, A.C. and Cole, L.J.R. (1998), "A survey of the use of computers in construction management in Australia", in: Lansley, P.R. and Harlow, P.A. (Eds), *Managing Construction Worldwide*, 1, 517-523.

Wager, D.M. (1998), "Construction management computing: yesterday, today and tomorrow", in Lansley, P.R. and Harlow, P.A. (Eds), *Managing Construction Worldwide: System for managing Construction*, **1**, 620-630.

Wilderspin, M. (1988), "Adopt a strategic approach to IT implementation", *Chartered Surveyor Monthly*, February, 58.